**RESULTS FROM EXPLORATORY WORK ON ABIOTIC VARIABLES**

**Goal:** determine which combination of abiotic variables and lags explains the highest variation in proportion of breeding individuals

**Methods:**

a.1. Develop model variations with different lags of 4 main predictors (NDVI, mean temp, warm and cool precip; *Note: cumulative values of warm and cool precip based on horizon=365, temp\_limit=40F*)

* Mod 1: all variables with lag of 0 and lag of 1
* Mod 2: all variables with lag of 0
* Mod 3: all variables with lag of 1
* Mod 4: temp and precip with lag of 1, precip with lag of 2

a.2. Determine which model variation best fits different subsets of data (i.e., PB males in control vs exclosure vs PB females in control vs PP males in control vs DM females in control)

- This is to assess the suitability of the “best fit” model (i.e., with *best* combination of variables) to different datasets (answers the question: does this combination of abiotic variables result to relatively high R2 when used as predictors for a different set of response variables?)

b. Determine which horizon (number of days) should be used to calculate cumulative values for warm and cool precip (30, 90, 180, 365; default is 365 and has been used in developing the different model variations so far)

**Results:**

*Note: values in bold indicate significance (p < 0.05), values in red ink indicate “best” fit model*

1. **Model variations applied to different datasets**
2. **PB male in control (abiotic only)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Mod 1** | **Mod 2** | **Mod 3** | **Mod 4** |
| NDVI (lag 0) | 0.13 | 0.04 | - | - |
| NDVI (lag 1) | -0.7 | - | -0.02 | -0.02 |
| Mean\_temp(lag 0) | 0.68 | 0.30 | - | - |
| Mean\_temp (lag 1) | **-1.53** | - | **-0.87** | **-0.84** |
| Warm\_precip (lag 0) | 0.66 | **0.42** | - | - |
| Warm\_precip (lag 1) | -0.32 | - | **0.34** | - |
| Warm\_precip (lag 2) | - | - | **-** | 0.23 |
| Cool\_precip (lag 0) | -0.43 | -0.61 | - | - |
| Cool\_precip (lag 1) | -0.27 | - | **-0.65** | - |
| Cool\_precip (lag 2) | - | - | **-** | **-0.86** |
| *Adj. R2* | *13.4%* | *15.1%* | *14.5%* | *17.1%* |

1. **PB male in exclosure (abiotic only)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Mod 1** | **Mod 2** | **Mod 3** | **Mod 4** |
| NDVI (lag 0) | -0.04 | **0.29** | - | - |
| NDVI (lag 1) | 0.29 | - | **0.27** | **0.27** |
| Mean\_temp(lag 0) | 0.31 | -0.12 | - | - |
| Mean\_temp (lag 1) | -0.47 | - | -0.52 | -0.49 |
| Warm\_precip (lag 0) | 0.86 | 0.00 | - | - |
| Warm\_precip (lag 1) | -0.99 | - | -0.11 | - |
| Warm\_precip (lag 2) | - | - | **-** | -0.23 |
| Cool\_precip (lag 0) | 0.73 | **-0.63** | - | - |
| Cool\_precip (lag 1) | -1.22 | - | **-0.69** | - |
| Cool\_precip (lag 2) | - | - | **-** | -0.84 |
| *Adj. R2* | *35.2%* | *33%* | *35%* | *38.8%* |

1. **PB female in control (abiotic only)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Mod 1** | **Mod 2** | **Mod 3** | **Mod 4** |
| NDVI (lag 0) | -0.45 | 0.21 | - | - |
| NDVI (lag 1) | **0.79** | - | **0.52** | **0.54** |
| Mean\_temp(lag 0) | -0.52 | -1.00 | - | - |
| Mean\_temp (lag 1) | **3.05** | - | **2.69** | 2.12 |
| Warm\_precip (lag 0) | **3.62** | **1.03** | - | - |
| Warm\_precip (lag 1) | **-2.88** | - | **0.89** | - |
| Warm\_precip (lag 2) | - | - | **-** | 0.54 |
| Cool\_precip (lag 0) | -1.69 | -0.93 | - | - |
| Cool\_precip (lag 1) | 1.47 | - | -0.77 | - |
| Cool\_precip (lag 2) | - | - | **-** | -0.38 |
| *Adj. R2* | *59%* | *53.4%* | *53.5%* | *50.2%* |

1. **PP male in control (abiotic only)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Mod 1** | **Mod 2** | **Mod 3** | **Mod 4** |
| NDVI (lag 0) | 0.32 | **0.45** | - | - |
| NDVI (lag 1) | 0.09 | - | **0.31** | **0.30** |
| Mean\_temp(lag 0) | -0.37 | -0.40 | - | - |
| Mean\_temp (lag 1) | **-1.82** | - | **-1.81** | **-1.61** |
| Warm\_precip (lag 0) | 0.91 | 0.17 | - | - |
| Warm\_precip (lag 1) | -0.80 | - | 0.10 | - |
| Warm\_precip (lag 2) | - | - | **-** | 0.00 |
| Cool\_precip (lag 0) | -1.00 | **-0.85** | - | - |
| Cool\_precip (lag 1) | 0.09 | - | -0.93 | - |
| Cool\_precip (lag 2) | - | - | **-** | **-0.79** |
| *Adj. R2* | *63.7%* | *61.7%* | *60.8%* | *58.6%* |

1. **DM female in control (abiotic only)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Mod 1** | **Mod 2** | **Mod 3** | **Mod 4** |
| NDVI (lag 0) | -0.03 | 0.13 | - | - |
| NDVI (lag 1) | **0.25** | - | **0.23** | **0.24** |
| Mean\_temp(lag 0) | 0.15 | 0.39 | - | - |
| Mean\_temp (lag 1) | 0.62 | - | 0.51 | **0.47** |
| Warm\_precip (lag 0) | 0.69 | **0.43** | - | - |
| Warm\_precip (lag 1) | -0.32 | - | **0.33** | - |
| Warm\_precip (lag 2) | - | - | **-** | **0.31** |
| Cool\_precip (lag 0) | 0.27 | **-0.12** | - | - |
| Cool\_precip (lag 1) | -0.40 | - | -0.18 | - |
| Cool\_precip (lag 2) | - | - | **-** | -0.20 |
| *Adj. R2* | *31.8%* | *29.5%* | *30.9%* | *30.4%* |

1. **PP female in exclosure (abiotic only)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Mod 1** | **Mod 2** | **Mod 3** | **Mod 4** |
| NDVI (lag 0) | -0.12 | **0.30** | **-** | - |
| NDVI (lag 1) | **0.68** | - | **0.48** | **0.48** |
| Mean\_temp(lag 0) | **2.97** | **2.59** | - | - |
| Mean\_temp (lag 1) | **2.01** | - | 0.79 | 0.76 |
| Warm\_precip (lag 0) | **2.23** | **0.37** | - | - |
| Warm\_precip (lag 1) | -2.04 | - | **0.00** | - |
| Warm\_precip (lag 2) | - | - | **-** | -0.25 |
| Cool\_precip (lag 0) | 1.72 | **-0.64** | - | - |
| Cool\_precip (lag 1) | -2.10 | - | **-0.61** | - |
| Cool\_precip (lag 2) | - | - | **-** | **-0.53** |
| *Adj. R2* | *45.6%* | *34.2%* | *36.4%* | *37.7%* |

1. **Determining Appropriate Horizon**
2. **PB male control**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Horizon (# of days)** | | | |
|  | **30 (1 month)** | **90 (3 months)** | **180 (6 months)** | **365 (1 year)** |
| NDVI (lag 0) | -0.12 | 0.11 | 0.33 | 0.13 |
| NDVI (lag 1) | 0.11 | -0.15 | -0.31 | -0.7 |
| Mean\_temp(lag 0) | 0.77 | 1.13 | 1.25 | 0.68 |
| Mean\_temp (lag 1) | **-1.77** | **-1.59** | -0.99 | **-1.53** |
| Warm\_precip (lag 0) | 0.53 | 0.20 | -0.45 | 0.66 |
| Warm\_precip (lag 1) | 0.04 | 0.58 | **1.44** | -0.32 |
| Cool\_precip (lag 0) | -0.31 | **0.25** | -0.31 | -0.43 |
| Cool\_precip (lag 1) | 0.32 | -0.26 | -0.53 | -0.27 |
| *Adj. R2* | *9.73%* | *10.6%* | *20.9%* | *13.4%* |

1. **PB male exclosure**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Horizon (# of days)** | | | |
|  | **30 (1 month)** | **90 (3 months)** | **180 (6 months)** | **365 (1 year)** |
| NDVI (lag 0) | -0.33 | -0.23 | 0.05 | -0.04 |
| NDVI (lag 1) | **0.38** | 0.29 | 0.13 | 0.29 |
| Mean\_temp(lag 0) | -0.03 | -0.08 | 0.38 | 0.31 |
| Mean\_temp (lag 1) | 0.01 | 0.17 | -0.36 | -0.47 |
| Warm\_precip (lag 0) | **0.75** | **1.19** | 0.43 | 0.86 |
| Warm\_precip (lag 1) | 0.26 | -0.45 | 0.36 | -0.99 |
| Cool\_precip (lag 0) | -0.01 | **1.08** | 0.57 | 0.73 |
| Cool\_precip (lag 1) | **0.84** | -0.49 | -1.25 | -1.22 |
| *Adj. R2* | *40.7%* | *37.3%* | *34.6%* | *35.2%* |

1. **PB female control**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Horizon (# of days)** | | | |
|  | **30 (1 month)** | **90 (3 months)** | **180 (6 months)** | **365 (1 year)** |
| NDVI (lag 0) | -0.33 | -0.50 | -0.26 | -0.45 |
| NDVI (lag 1) | 0.53 | 0.20 | 0.18 | **0.79** |
| Mean\_temp(lag 0) | -1.59 | -0.62 | -1.29 | -0.52 |
| Mean\_temp (lag 1) | 2.57 | 1.88 | **3.86** | **3.05** |
| Warm\_precip (lag 0) | 0.98 | **1.94** | 1.71 | **3.62** |
| Warm\_precip (lag 1) | 0.97 | 0.62 | **0.64** | **-2.88** |
| Cool\_precip (lag 0) | -2.12 | **-0.32** | 0.32 | 1.72 |
| Cool\_precip (lag 1) | 0.23 | **1.77** | 0.60 | -2.10 |
| *Adj. R2* | *56.1%* | *60.4%* | *59.3%* | *59%* |

1. **PP male control**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Horizon (# of days)** | | | |
|  | **30 (1 month)** | **90 (3 months)** | **180 (6 months)** | **365 (1 year)** |
| NDVI (lag 0) | 0.27 | **0.33** | **0.36** | 0.32 |
| NDVI (lag 1) | -0.03 | -0.09 | 0.03 | 0.09 |
| Mean\_temp(lag 0) | -0.13 | -0.39 | -0.54 | -0.37 |
| Mean\_temp (lag 1) | **-1.92** | **-1.68** | -1.22 | **-1.82** |
| Warm\_precip (lag 0) | 0.49 | 0.90 | -0.51 | 0.91 |
| Warm\_precip (lag 1) | 0.00 | -0.38 | 1.16 | -0.80 |
| Cool\_precip (lag 0) | -0.55 | -0.68 | 1.27 | -1.00 |
| Cool\_precip (lag 1) | -0.36 | 0.04 | **-1.94** | 0.09 |
| *Adj. R2* | *63.5%* | *64.1%* | *62.8%* | *63.7%* |

1. **DM female control**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Horizon (# of days)** | | | |
|  | **30 (1 month)** | **90 (3 months)** | **180 (6 months)** | **365 (1 year)** |
| NDVI (lag 0) | 0.07 | 0.03 | -0.00 | -0.03 |
| NDVI (lag 1) | 0.18 | 0.14 | 0.15 | **0.25** |
| Mean\_temp(lag 0) | 0.10 | 0.10 | 0.22 | 0.15 |
| Mean\_temp (lag 1) | 0.30 | 0.43 | 0.64 | 0.62 |
| Warm\_precip (lag 0) | -0.04 | 0.07 | 0.50 | 0.69 |
| Warm\_precip (lag 1) | 0.29 | 0.43 | 0.15 | -0.32 |
| Cool\_precip (lag 0) | -0.20 | -0.43 | -0.15 | 0.27 |
| Cool\_precip (lag 1) | -0.11 | **0.45** | 0.23 | -0.40 |
| *Adj. R2* | *30.1%* | *31.4%* | *31.5%* | *31.8%* |

1. **PP female exclosure**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Horizon (# of days)** | | | |
|  | **30 (1 month)** | **90 (3 months)** | **180 (6 months)** | **365 (1 year)** |
| NDVI (lag 0) | -0.19 | -0.04 | -0.02 | -0.12 |
| NDVI (lag 1) | **0.64** | **0.39** | **0.36** | **0.68** |
| Mean\_temp(lag 0) | **3.57** | **3.43** | **3.41** | **2.97** |
| Mean\_temp (lag 1) | **2.02** | **2.60** | **1.89** | **2.01** |
| Warm\_precip (lag 0) | **1.30** | **1.83** | **1.97** | **2.23** |
| Warm\_precip (lag 1) | -0.00 | -0.55 | -0.62 | -2.04 |
| Cool\_precip (lag 0) | -0.23 | 0.15 | **1.21** | 1.72 |
| Cool\_precip (lag 1) | 0.25 | 0.17 | **-1.07** | -2.10 |
| *Adj. R2* | *41.7%* | *39.9%* | *38.5%* | *45.6%* |

**Notes:**

* It seems that using abiotic variables with lags of 0 and 1 as predictors result to best fit models for multiple datasets, in general (based on R2 value)
* The effect of warm\_precip at different lags vary. At lag 0, it is positive but at lag 1, it is negative. What does the positive effect of warm precip with a lag of 0 mean? If the cumulative amount of rainfall above the temperature limit in the past 365 days is high, rodents are more likely to reproduce? (i.e., the high breeding odds in April 2000 is associated with the high amount of “warm” rain from April 1999 to 2000 or is it the high amount of warm rain from April 1999 to 2000 associated with high number of breeding individuals in future months like August or something?). Why? Does higher number of warm days (with rain) in a year benefit the plants/rodents better? Or will rodents think that if the cumulative amount of “warm” rain up until their breeding month is high enough to support high primary productivity for a couple of months forward, they’ll be reproductive because that would mean their young would have enough resources to fend for themselves? What does a negative association between warm precip and P(breeding) mean when there is a lag of 1 applied? If the cumulative rainfall in the last 13 months is high, rodents are less likely to be reproductive? (i.e., the high breeding odds in April 2000 is associated with low cumulative rain since March of 1999?). Does it still make sense to add a lag if the horizon is one year?
* The “best” horizon to use to calculate cumulative values of warm and cool precip is either 365 days (1 year) or 90 days (~3 months) for atleast 2 datasets. I explored the 3 months horizon because I was thinking of breaking up the year into quarters and a conventional view of seasons. I’m not sure which one makes more biological sense. Since it is a water limited system, does longer horizon make more sense? Why? Can we think of 365-day horizon as an indicator for *potential* resource availability? Or does the cumulative rainfall in a relatively short period of time (3 months) make more sense if we’re thinking about how plants that grow in the most proximate period as the breeding event will be used as a resource by rodents (and think of the 90-day horizon as a proxy for *actual* resource availability)?